

# **General Electric Advanced Technology Manual**

## **Chapter 4.12**

### **Emergency Action Levels**

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## **4.12 Emergency Action Levels**

### **Learning Objectives**

1. State the purpose of an emergency plan.
2. Identify the 4 classes of emergency events, including their order of severity.
3. Identify the amount of time allowed for event classification and off site notifications.
4. Identify the 4 facilities used in a site emergency plan response
5. Given the NUMARC EALS classify the event.
6. Identify the 3 NRC response modes to an emergency event

### **4.12.1 Introduction**

The purpose of an Emergency Action Level (EAL) is to trigger the declaration of an emergency classification level (ECL), which, in turn, triggers a certain level of emergency response. Emergency Plan actions are directed toward providing the following:

- Correct classification of the event based upon plant conditions.
- Timely communications of plant, radiological and meteorological conditions to offsite emergency response authorities and federal agencies.
- Technical support for the operations staff to assist in accident mitigation.
- Recommendations to the state(s) and county(s) on the need to evacuate or shelter the Emergency Planning Zone (EPZ).
- Coordination of off site agency (NRC, FEMA, INPO etc.) support for accident mitigation

### **4.12.2 Emergency Plan Guidance Documents**

10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," states that no operating license for a nuclear power reactor will be issued by the NRC unless there is a reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency. For currently operating power reactors, 10 CFR 50.54(s)(2)(ii) requires that if emergency preparedness does not provide adequate protective measures in the event of a radiological emergency, the NRC can shutdown the reactor until such deficiencies are remedied.

Onsite and Offsite emergency plans must meet the standards of 10 CFR 50.47 for the staff to determine there is reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency. 10 CFR 50.47(b)(4), pertains to the development of emergency classification and actions level scheme. Section IV",

Content of Emergency Plans”, of Appendix E to 10 CFR Part 50 also contains requirements for the development and review of EALs.

There are 3 potential standards documents that may be in use for the development of emergency planning.

- NUREG-0654/FEMA-REP-1
- NUMARC/NESP-007
- NEI 99-01

A large majority of the plants currently use either the NUMARC or NEI versions of the emergency plan, so these will be reviewed in this chapter

#### **4.12.3 Emergency Classifications and Notifications**

Regardless of the document used as a standard, the basic structure of the emergency plan will include 4 classifications of events. In order of severity they are;

- Notification of Unusual Event (NOUE)
- Alert
- Site Area Emergency (SAE)
- General Emergency (GE)

Because of the potential need to take immediate offsite actions the utility staff has 15 minutes from having indications that there is an event to classify the event and make the emergency declaration. Due to the potential for a significant radiological accident, notifications to appropriate offsite response organizations come directly from the facility. The state(s) and county(s) must be notified within 15 minutes of event declaration. The NRC must be notified as soon as possible, but within 1 hour of the event declaration. The response organizations that receive these notifications have the authority and capability to take immediate predetermined actions to protect the public.

The lowest level of emergency action levels, Notification of Unusual Events classification, is comprised of events in progress, or which have occurred, that indicate a potential degradation of the level of safety of the station. No releases of radioactive material requiring offsite response or monitoring are expected.

The next higher classification, Alert, is comprised of events in progress, or which have occurred, that involve actual or potentially substantial degradation of the safety level of the station. Minor releases of radioactivity are possible. Any releases expected to be limited to small fractions of EPA Protective Action Guideline exposure levels.

The Site Area Emergency classification is comprised of events in progress, or which have occurred, that involve actual or potential major failure of plant functions needed for protection of the public. Releases are not expected to exceed EPA Protective Action Guidelines, except near the Site Boundary.

The highest level classification, General Emergency, is comprised of events in progress, or which have occurred, that involve actual or imminent substantial core degradation or melting with a potential for the loss of the primary containment integrity. Release can be expected to exceed EPA Protective Action Guideline exposure levels offsite for more than the immediate site area.

At the General Emergency classification, the utility is required to provide Protective Action Recommendations (PARS), to the state(s) and county(s). These include recommendations to shelter or evacuate a portion of the population in the Emergency Planning Zone (EPZ). Local governments will take these utility protective action recommendations (PARs) and take any of the following actions;

- advisories to the public in certain areas to stay inside (shelter)
- advisories to evacuate to predetermined relocation host areas.

#### **4.12.4 Emergency Facilities**

Sites have multiple facilities to support implementation of the emergency plan. In general there are four facilities that directly support plant emergency response.

The Control Room is where any initial emergency classification is performed. The operating crew is responsible for recognition of conditions that require an entry into the emergency plan. The Shift Manager is responsible for the declaration of the event and notification to off site authorities. The Control Room will remain the response center for the emergency plan until the other facilities are activated.

The Technical Support Center (TSC) is activated at either the NOUE or Alert level in order to control the implementation of the site emergency response organization. Personnel in the TSC will include individuals representing site maintenance, radiation protection, security, operations and engineering. When fully staffed, they will assume responsibility for any further emergency plan classifications and notifications. In addition they provide technical support and command/control for any repair efforts needed to mitigate the event.

The Operations Support Center (OSC) is staffed concurrent with the TSC. This will include skilled workers from the maintenance, security, operations and radiation protection staffs. These personnel will implement the repair efforts as directed by the TSC staff.

The Emergency Operations Facility (EOF) is staffed at the ALERT or SAE level in order to coordinate any off site assistance needed for event mitigation. When fully staffed the EOF will assume responsibility for emergency plan classifications and notifications. The TSC will continue to direct the in plant activities, while coordinating with the EOF for any off site assistance needed for event mitigation. The EOF will contain sufficient staff to support the TSC, along with additional personnel needed to support in field radiation

monitoring and dose assessment. Unlike the TSC and the OSC, the EOF may not be located at the site.

Additional facilities may be part of the emergency planning response team. These may include facilities to handle media attention and alternate facilities for the TSC, OSC and EOF in the event that the on site structures are not available.

#### **4.12.5 NRC Emergency Response**

The NRC also uses a graduated response to emergency conditions at commercial nuclear facilities. The NRC Incident Response guideline (MD 8.2) defines the NRC's response to emergencies and includes;

- Roles responsibilities within the NRC
- Roles and responsibilities of other agencies
- Response modes for incidents.
- Guidance on incident response team makeup

The NRC is the coordinating agency for technical response to an emergency event. If the severity of an event rises to a General Emergency or is terrorist related, the Department of Homeland security becomes the lead agency, with the NRC still providing technical support.

The NRC has three response modes depending upon the severity of the event;

- **Monitoring:** A heightened state of readiness for information acquisition and assessment. At the monitoring stage, the regional incident response center (IRC) is staffed, and the NRC headquarters is staffed as needed to support the regional IRC.
- **Activation:** Members of the Executive Team lead the emergency response organization. The needed reactor safety, protective measures, fuel cycle safety and liaison personnel staff the Headquarters Operations Center (HOC). The regional incident response center (IRC) is staffed at this point if not activated in the monitoring phase. The region may also assemble and dispatch a site team to support the NRC's on site efforts for emergency response.
- **Expanded Activation:** If a larger response is still needed, the agency will initiate expanded activation. At this point, the Chairman assumes the lead for the NRC's emergency response activities. The NRC will fully staff the HOC and the affected region's IRC. If not done during Activation, the region will dispatch a site team for onsite assessment and face-to-face coordination with the utility.

#### **4.12.6 Summary**

The purpose of an emergency action level (EAL) is to trigger the declaration of an emergency classification level (ECL). This in turn, triggers a certain level of emergency response by the utility, local governments and the NRC. Actions are directed toward

providing information to offsite emergency response authorities and federal agencies (e.g. plant conditions, meteorological conditions, and radiological field monitoring results). Licensee's actions to respond directly to the onsite situation are governed by emergency operating procedures. Emergency action levels are used by plant personnel in determining the appropriate ECL to declare. Nuclear Power Plants write their procedures by following at least one of the three emergency response plans:

- Revision 1 to NUREG-0654/FEMA-REP-1, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants,"
- Nuclear Utilities Management and Resource Council (NUMARC) issued Revision 2 of NUMARC / NESP-007, "Methodology for Development for Emergency Action Levels"
- Nuclear Energy Institute (NEI) submitted NEI 99-01, Methodology for Development of Emergency Action Levels

Onsite and Offsite emergency response plans must meet the standards that are listed in 10 CFR 50.47 in order for the staff to make a positive finding that there is reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency. One of these standards, 10 CFR 50.47(b)(4), pertains to the development of emergency classification and actions level scheme. Section IV, "Content of Emergency Plans", of Appendix E to 10 CFR Part 50 also contains requirements for the development and review of EALs.

**Table 4.12-1 NUMARC/NESP-007 Fission Product Barrier Matrix**

Fission Product Barrier Matrix									
GENERAL EMERGENCY			SITE AREA EMERGENCY			ALERT		UNUSUAL EVENT	
FG1 Loss of ANY two barriers AND Loss or Potential Loss of third barrier.			FS1 Loss or Potential Loss of ANY two barriers.			FA1 ANY Loss or ANY Potential Loss of either Fuel Clad or RCS.		FU1 ANY Loss or ANY Potential Loss of Containment.	
FC - Fuel Clad			RC - Reactor Coolant System			CT - Containment			
Sub-Category	Loss	Potential Loss	Loss	Potential Loss	Loss	Potential Loss	Potential Loss		Hot Matrix
1. RCS Activity →	Coolant activity > 300 uCi/gm Dose Equivalent I-131	None	None	None	None	None	None		
2. RPV Water Level →	1. RPV level < -189 in. without adequate core spray. OR 2. RPV level < -210 in.	RPV level < -158 in. (TAF).	RPV level < -158 in. (TAF).	None	None	None	Plant conditions indicate that Primary Containment Flooding is required.		
3. Drywell Pressure →	None	None	1. Drywell pressure > 1.69 psig. AND 2. Drywell pressure rise due to RCS leakage.	None	None	1. Rapid unexplained drop in Drywell pressure following initial pressure rise. OR 2. Drywell pressure response not consistent with LOCA conditions.	1. Drywell pressure ≥ 50 psig and rising. OR 2. a. Drywell or suppression chamber hydrogen concentration ≥ 6%. AND b. Drywell or suppression chamber oxygen concentration ≥ 5%.		
4. RCS Leakrate →	None	None	1. UNISOLABLE Main Steam Line (MSL) break as indicated by the failure of both MSIVs in ANY one line to close. AND 2. a. High MSL Flow AND High Steam Tunnel Temperature. OR b. Direct report of steam release.	1. RCS leakage > 50 gpm inside the drywell. OR 2. UNISOLABLE primary system leakage outside drywell as indicated by Secondary Containment area temperatures or radiation levels > Maximum Normal operating levels.			Table F2 Drywell Radiation Thresholds Time After Shutdown (hrs) Potential Loss (R/hr) ≤ 2 4.35 E+02 > 2 to 4 3.75 E+02 > 4 to 8 3.15 E+02 > 8 to 16 2.60 E+02 > 16 to 23 2.30 E+02 > 23 2.25 E+02		
5. HI Cont/Drywell Rad →	Drywell radiation monitor reading > Fuel Cladding Loss Threshold, Table F1.	None	1. Drywell Radiation monitor reading > 100 R/hr AND 2. Indications of RCS leakage into the Drywell.	None	None	None	Drywell radiation monitor reading > Containment Potential Loss Threshold, Table F2.		
6. Breach/Bypass →	Table F1 Drywell Radiation Thresholds Time After Shutdown (hrs) Fuel Cladding Loss (R/hr) ≤ 2 1.90 E+02 > 2 to 4 1.65 E+02 > 4 to 8 1.40 E+02 > 8 to 16 1.12 E+02 > 16 to 23 9.90 E+01 > 23 9.65 E+01		None	None	1. a. Failure of all isolation valves in any one line to close. AND b. A downstream pathway to the environment exists. OR 2. Intentional venting/purging of Primary Containment per EOPs or SAGs due to accident conditions. OR 3. UNISOLABLE primary system leakage outside drywell as indicated by Secondary Containment area temperatures or radiation levels > Maximum Safe operating levels.	None			
7. ED Judgment →	Any condition in the opinion of the Emergency Director that indicates Loss of the Fuel Clad Barrier.	Any condition in the opinion of the Emergency Director that indicates Potential Loss of the Fuel Clad Barrier.	Any condition in the opinion of the Emergency Director that indicates Loss of the RCS Barrier.	Any condition in the opinion of the Emergency Director that indicates Potential Loss of the RCS Barrier.	Any condition in the opinion of the Emergency Director that indicates Loss of the Containment Barrier.	Any condition in the opinion of the Emergency Director that indicates Potential Loss of the Containment Barrier.			

Modes: 1 – Power Operation, 2 – Startup, 3 – Hot Shutdown, 4 – Cold Shutdown, 5 – Refueling, D – Defueled

**Table 4.12-2 NUMARC/NESP-007 Example of an EAL Recognition Matrix**

GENERAL EMERGENCY		SITE AREA EMERGENCY		ALERT		UNUSUAL EVENT				
Hazards and Other Conditions Affecting Plant Safety										
<div>HG1 Security event resulting in loss of physical control of the facility.</div> <div><u>EAL Threshold Values:</u></div> <div>A HOSTILE FORCE has taken control of:</div> <div>1. Plant equipment such that plant personnel are unable to operate equipment required to maintain safety functions (Table H1).</div> <div>OR</div> <div>2. Spent Fuel Pool cooling systems if imminent fuel damage is likely (e.g, reactor fuel off-loaded in pool within 120 days).</div>	<div>HS1 Site attack</div> <div><u>EAL Threshold Values:</u></div> <div>A notification from the site Security Force that an armed attack, explosive attack, LARGE AIRCRAFT impact, or other HOSTILE ACTION is occurring or has occurred within the PROTECTED AREA.</div>	<div>HS3 Confirmed security event in a plant VITAL AREA</div> <div><u>EAL Threshold Values:</u></div> <div>Notification by the Security Force of a security event in a plant VITAL AREA as determined from Station Security Plan – Appendix C.</div>	<div>HS4 Control Room evacuation has been initiated and plant control cannot be established.</div> <div><u>EAL Threshold Values:</u></div> <div>1. Control Room evacuation has been initiated</div> <div>AND</div> <div>2. Control of the plant <u>cannot</u> be established per LOA-RX 101 (201) in &lt; 15 minutes</div>	<div>HS1 Notification of an airborne attack threat</div> <div><u>EAL Threshold Values:</u></div> <div>A validated notification from NRC of a LARGE AIRCRAFT attack threat &lt; 30 minutes away.</div>	<div>HA1</div> <div><u>EAL Threshold Values:</u></div> <div>A notification from the site Security Force that an armed attack, explosive attack, LARGE AIRCRAFT impact, or other HOSTILE ACTION is occurring or has occurred within the OWMER CONTROLLED AREA.</div>	<div>HA2 Notification of HOSTILE ACTION within the OWMER CONTROLLED AREA.</div> <div><u>EAL Threshold Values:</u></div> <div>A notification from the site Security Force that an armed attack, explosive attack, LARGE AIRCRAFT impact, or other HOSTILE ACTION is occurring or has occurred within the OWMER CONTROLLED AREA.</div>	<div>HA3 Confirmed security event in a plant PROTECTED AREA</div> <div><u>EAL Threshold Values:</u></div> <div>Notification by the Security Force of a security event in a plant PROTECTED AREA as determined from Station Security Plan – Appendix C.</div>	<div>HA4 Control Room evacuation has been initiated.</div> <div><u>EAL Threshold Values:</u></div> <div>Entry into LOA-RX-101(201) for Control Room evacuation.</div>	<div>HU1 Confirmed terrorism security event which indicates a potential degradation in the level of safety of the plant</div> <div><u>EAL Threshold Values:</u></div> <div>1. A credible site-specific security threat notification as determined per SY-AA-101-132, "Threat Assessment,"</div> <div>OR</div> <div>2. A validated notification from NRC providing information of an aircraft threat</div>	<div>HU3 Confirmed security event which indicates a potential degradation in the level of safety of the plant</div> <div><u>EAL Threshold Values:</u></div> <div>Notification by the Security Force of a security event as determined from Station Security Plan – Appendix C.</div>
	Security									
	<div>Table H1 - Safety Functions and Related Systems</div> <div><ul style="list-style-type: none"><li>Reactivity Control (ability to shut down the reactor and keep it shutdown)</li><li>RCS Inventory (ability to cool the core)</li><li>Secondary Heat Removal (ability to maintain heat sink)</li><li>Fission Product Barriers</li></ul></div>									
	C. R. Evac									

## Table 4.12-3 EAL BASES DOCUMENT (HG-1)

### **HG-1 Initiating Condition:**

Security event resulting in loss of physical control of the facility.

### **Operating Mode Applicability:**

1, 2, 3, 4, 5, D

### **EAL Threshold Value:**

A HOSTILE FORCE has taken control of Plant equipment such that plant personnel are unable to operate equipment required to maintain safety functions.

**OR**

Spent Fuel Pool cooling systems if imminent fuel damage is likely (e.g., reactor fuel off-loaded in pool within 120 days).

### **Basis:**

**HOSTILE FORCE:** One or more individuals who are engaged in a determined assault, overtly or by stealth and deception, equipped with suitable weapons capable of killing, maiming, or causing destruction.

### **Threshold #1 Basis**

This threshold encompasses conditions under which a **HOSTILE FORCE** has taken physical control of **VITAL AREAS** (containing vital equipment or controls of vital equipment) required to maintain safety functions. As a result, equipment control cannot be transferred to and operated from another location. If control of the plant equipment necessary to maintain safety functions can be transferred to another location, then the above EAL Threshold is not met. Loss of physical control of the Control Room or remote shutdown capability alone may not prevent the ability to maintain safety functions. Design of the remote shutdown capability and the location of the transfer switches should be taken into account.

### **Threshold #2 Basis**

This threshold addresses loss of physical control of spent fuel pool cooling systems if imminent fuel damage is likely because there is freshly off-loaded fuel in the pool. The condition "freshly off-loaded reactor fuel in pool" equates to fuel off-loaded within the last 120 days.

#### Table 4.12-4 EAL BASES DOCUMENT (HS-1)

**HS-1 Initiating Condition:**

Site attack.

**Operating Mode Applicability:**

1, 2, 3, 4, 5, D

**EAL Threshold Values:**

A notification from the site Security Force that an armed attack, explosive attack, **LARGE AIRCRAFT** impact, or other **HOSTILE ACTION** is occurring or has occurred within the **PROTECTED AREA**.

**Basis:**

**LARGE AIRCRAFT:** Aircraft as large as or larger than passenger airliners or air cargo / freight planes (for example; 737, DC9, MD80, MD90, 717 or C-130). Examples of aircraft that would not be considered large are general aviation Cessna, Piper and Lear type private planes as well as police, medical and media helicopters.

**HOSTILE ACTION:** An act toward a Nuclear Power Plant or its personnel that includes the use of violent force to destroy equipment, take hostages, and/or intimidate the licensee to achieve an end. This includes attack by air, land, or water using guns, explosives, projectiles, vehicles, or other devices used to deliver destructive force. Other acts that satisfy the overall intent may be included. **HOSTILE ACTION** should not be construed to include acts of civil disobedience or felonious acts that are not part of a concerted attack on the Nuclear Power Plant. Non-terrorism-based EALs should be used to address such activities, (e.g., violent acts between individuals in the **OWNER CONTROLLED AREA**).

**PROTECTED AREA:** An area that normally encompasses all controlled areas within the security protected area fence. This class of security events represents an escalated threat to plant safety above that contained in the Alert ICs (HA1 and HA2) in that a hostile force has progressed from the **OWNER CONTROLLED AREA** to the Protected Area. Although Nuclear Power Plant security officers are well trained and prepared to protect against **HOSTILE ACTION**, it is appropriate for Offsite Response Organizations (ORO) to be notified and encouraged to begin preparations for public protective actions (if they do not normally) to be better prepared should it be necessary to consider further actions.

This EAL is intended to address the potential for a very rapid progression of events due to a dedicated attack. It is not intended to address incidents that are accidental or acts of civil disobedience, such as hunters or physical disputes between employees within the Owner Controlled area (OCA or PA). That initiating condition is adequately addressed by other EALs. **HOSTILE ACTION** identified above encompasses various acts including:  
Air attack (**LARGE AIRCRAFT** impacting the protected area)  
Land-based attack (**HOSTILE FORCE** penetrating protected area)  
Waterborne attack (**HOSTILE FORCE** on water penetrating protected area)  
A bomb exploding in the protected area.

## Table 4.12-5 EAL BASES DOCUMENT (HA-1)

### HA-1 Initiating Condition:

Notification of an airborne attack threat.

### Operating Mode Applicability:

1, 2, 3, 4, 5, D

### EAL Threshold Values:

A validated notification from NRC of a **LARGE AIRCRAFT** attack threat < 30 minutes away.

### Basis:

**LARGE AIRCRAFT:** Aircraft as large as or larger than passenger airliners or air cargo / freight planes (for example; 737, DC9, MD80, MD90, 717 or C-130). Examples of aircraft that would not be considered large are general aviation Cessna, Piper and Lear type private planes as well as police, medical and media helicopters. **LARGE AIRCRAFT** is meant to be an aircraft with the potential for causing significant damage to the plant. The status and size of the plane may be provided by NORAD through the NRC.

The intent of this EAL is to ensure that notifications for the security threat are made in a timely manner and that Offsite Response Organizations (ORO) and plant personnel are at a state of heightened awareness regarding the credible threat. Only the plant to which the specific threat is made need declare the Alert. This EAL is met when a plant receives information regarding a **LARGE AIRCRAFT** attack threat from NRC and the **LARGE AIRCRAFT** is less than 30 minutes away from the plant.

This EAL is intended to address the contingency for a very rapid progression of events due to an airborne hostile attack such as that experienced on September 11, 2001. This EAL is not premised solely on the potential for a radiological release. Rather the issue includes the need for assistance due to the possibility for significant and indeterminate damage from such an attack. Although vulnerability analyses show nuclear power plants to be robust, it is appropriate for OROs to be notified and encouraged to activate to be better prepared should it be necessary to consider further actions.

## Table 4.12-6 EAL BASES DOCUMENT (HU-1)

### **HU1 Initiating Condition:**

Confirmed terrorism security event which indicates a potential degradation in the Level of safety of the plant.

### **Operating Mode Applicability:**

1, 2, 3, 4, 5, D

### **EAL Threshold Values:**

A credible site-specific security threat notification OR a validated notification from NRC providing information of an aircraft threat.

### **Threshold #1 Basis**

The intent of this threshold is to ensure that appropriate notifications for the security threat are made in a timely manner. This includes information of a credible threat.

The determination of “credible” is made through use of information found in the Station Security Plan.

### **Threshold #2 Basis**

The intent of this threshold is to ensure that notifications for the security threat are made in a timely manner and that Offsite Response Organizations and plant personnel are at a state of heightened awareness regarding the credible threat. Only the plant to which the specific threat is made need declare the Unusual Event. This threshold is met when a plant receives information regarding an aircraft threat from NRC. Should the threat involve a **LARGE AIRCRAFT** (**LARGE AIRCRAFT** is meant to be an aircraft with the potential for causing significant damage to the plant), then escalation to Alert via HA1 would be appropriate if the **LARGE AIRCRAFT** is less than 30 minutes away from the plant. The status and size of the plane may be provided by NORAD through the NRC. It is not the intent of this EAL to replace existing non-hostile related EALs involving aircraft.